RF6 Benchmarks

RF6 has not yet restarted. Our plan before the freeze, which we plan to keep, is to base our report around 3 solicited white papers, one for each of the following *Big Ideas*:

- Detect dark matter particle production (production reaction or through subsequent DM scattering), with a focus on exploring sensitivity to thermal DM interaction strengths, e.g. DM production through the vector portal, milicharged particles, nu-portal DM production, etc.

- Explore the structure of the dark sector by producing and detecting unstable dark particles: *Minimal Portal Interactions*. This includes scalar portal (e.g. secluded DM), pseudoscalar portal (e.g. SIMP mediator), vector portal (visible signals, e.g. minimal A', iDM, SIMP mediators, etc), fermion portal (e.g. nu-portal fermion decays), …

- New Flavors and Rich Structures in Dark Sectors, e.g. various phobic and philic models, higher-dimensional operators, additional non-minimal dark-sector structure, etc.

More details can be found in our RF6 report outline document. The final details still need to be hashed out on what precisely goes into each white paper. This will be done in the few coming months.

N.b., plan to collect all results in a similar way to DarkCast (possibly in DarkCast itself) to enable remaking plots easily at later stages in the Snowmass process.

Natalia's Table

Benchmarks in Final State x Portal Organization

	DM Production	Mediator Decay Via Portal	Structure of Dark Sector
Vector	*m_χ vs. y [m_A/m_χ=3,α_D=.5]* **$m_{A'}$ vs. y** [α_D=0.5, 3 m_χ values] $\underline{m_\chi \text{ vs.} \alpha_D \text{ [} m_{A'}/m_\chi\text{=3, y=y}_{fo}\text{]}}$ m_χ vs. m_A [α_D=0.5, y=y_{fo}] *Millicharge m vs. q*	$\underline{m_{A'} \text{ vs. } \epsilon \text{ [decay-mode agnostic]}}$ ***$m_{A'}$ vs. ϵ [decays]***	**iDM m_χ vs. y [$m_{A'}/m_\chi$=3,α_D=.5] (anom connection)** **SIMP-motivated cascades [slices TBD]** $U(1)_{B-L\ /\ \mu-\tau\ /\ B-3\tau}$ (DM or SM decays)
Scalar	m_χ vs. sinθ [λ=0, fix m_S/m_χ, g_D] (thermal target excluded 1512.04119, should still include) Note secluded DM relevance of S→SM of mediator searches	*m_S vs. sinθ* [λ=0] *m_S vs. sinθ* [λ=s.t. Br(H→ϕϕ ~10^{-2})]?	Dark Higgs-sstrahlung (w/vector) scalar SIMP models? Leptophilic/leptophobic dark Higgs?
Neutrino	e/μ/τ a la1709.07001?	*m_N vs. U_e* *m_N vs. U_μ* *m_N vs. U_τ* Think more about reasoanble flavor structures	Sterile neutrinos with new forces?
ALP	m_χ vs. fq/l [λ=0, fix m_a/m_χ, g_D] (thermal target excluded) What about f_γ, f_G?	*m_a vs. f_γ* *m_a vs. f_G* *m_a vs. f_q=f_l* (separate?) Think more about reasoanble coupling relations including $f_{W/Z}$	FV axion couplings

\+ Neutron portal (See e.g. 2003.02270)? Hidden valleys (or are these out-of-scope?)?

Bold = BRN benchmark, *italic=PBC benchmark.* others are new suggestions. Underline=CV benchmarks that were not used in BRN